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(56) Documents Cited
GB 2284060 A **GB 2274514 A** **US 5790586 A**
US 5673692 A

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INT CL[6] **A61B 5/00 , G01K 13/00**
Online: WPI, EPODOC, JAPIO

(54) Abstract Title
Medical thermometer

(57) A medical thermometer which detects radiation from a body surface, used primarily for physiological measurements, has a main body with a single-chip central processing unit (1) to which a temperature sensing circuit (2), a liquid crystal display (4), a memory for storing programs (3), a communication interface (5) including a voice chip and infrared transmission means, a heartbeat sensing circuit (7), a bulb driving circuit (6) and a timing circuit (8) are electrically connected. The heartbeat sensing circuit along with a sensing device detects the human heartbeats from the finger capillary pulse. The bulb driving circuit actuates a light source in the main body for illumination purposes. The voice chip provides a voice indication of the temperature or heartbeat value via a speaker. The infrared transmission means enables data communication between the thermoscan and an external personal computer or microcomputer. The timing circuit can trigger an alarm by presetting the countdown so as to inform the user to re-measure or take medicine.

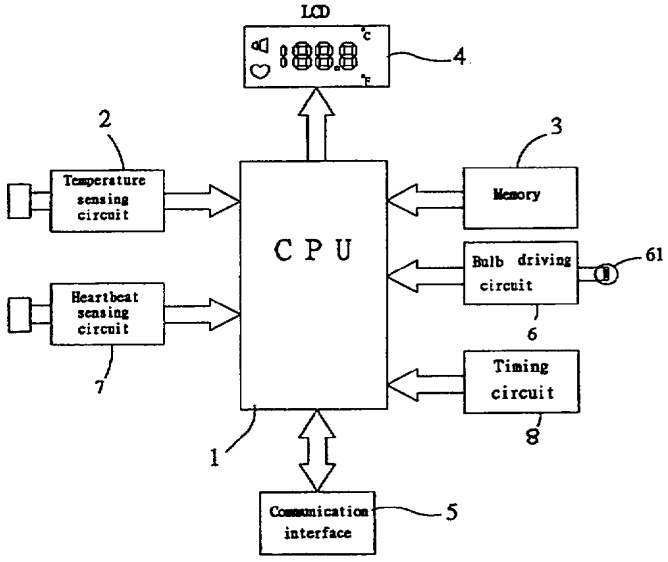

Fig.4

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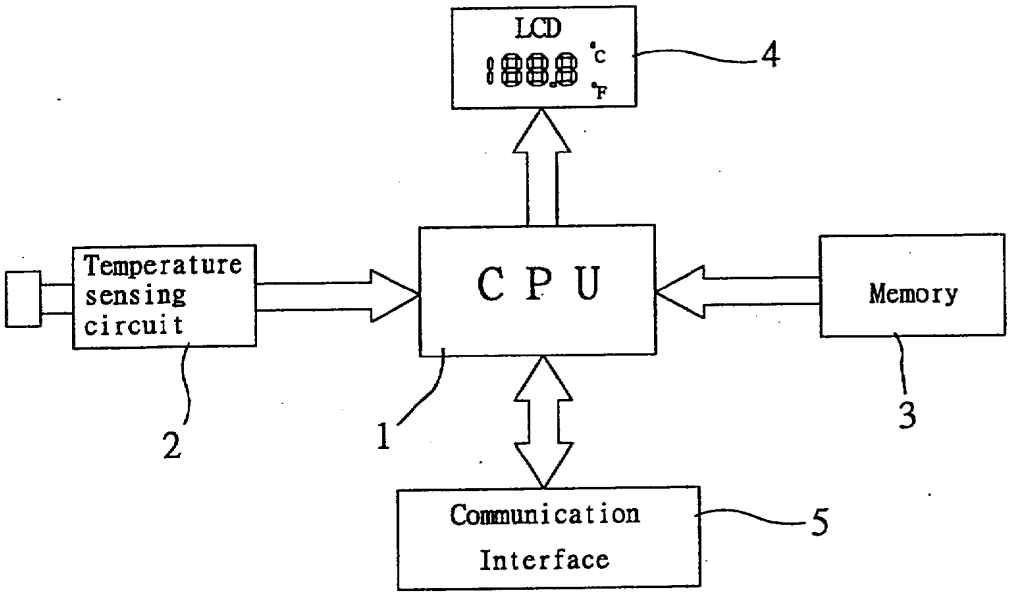
LCD
°C
°F
4
Temperature sensing circuit
C P U
Memory
2
1
3
Communication Interface
5

Fig.1

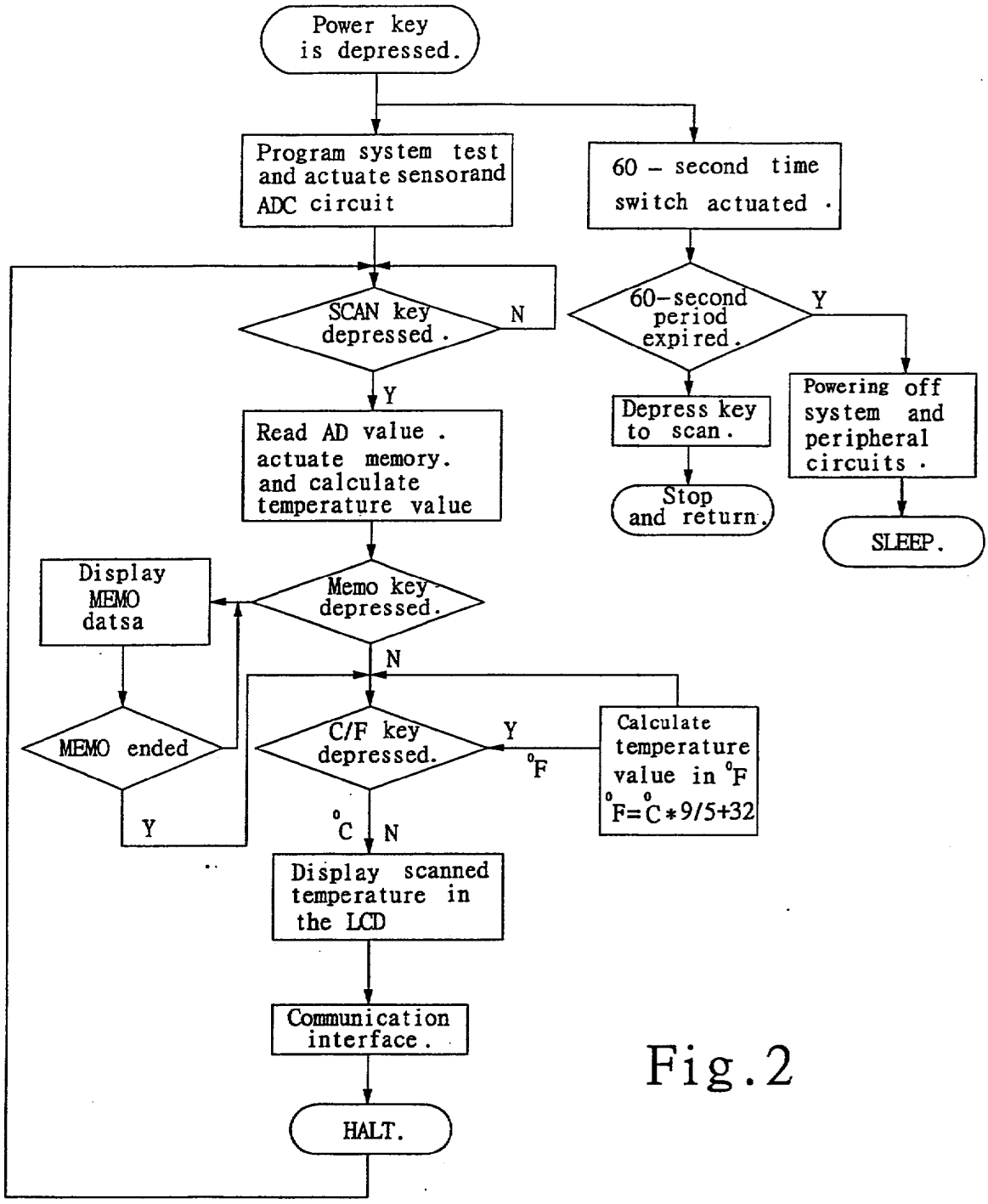
Power key is depressed.
Program system test and actuate sensorand ADC circuit
60 – second time switch actuated .
SCAN key depressed .
N
Y
60–second period expired.
Y
Depress key to scan.
Stop and return.
Powering off system and peripheral circuits .
SLEEP.
Read AD value . actuate memory. and calculate temperature value
Display MEMO datsa
Memo key depressed.
N
MEMO ended
Y
C/F key depressed.
Y
°F
Calculate temperature value in °F
°F=°C*9/5+32
°C
N
Display scanned temperature in the LCD
Communication interface.
HALT.

Fig.2

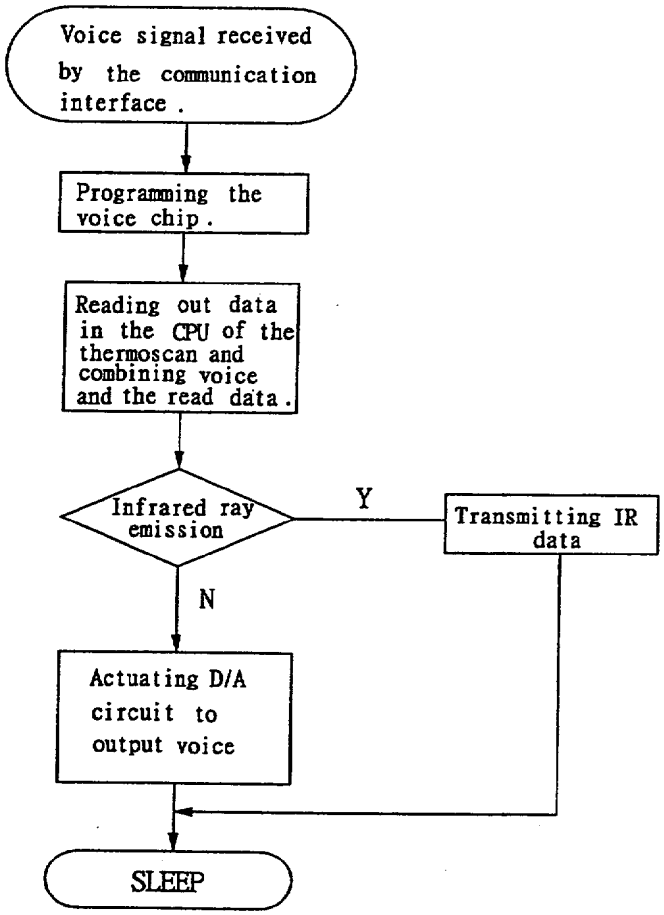
Voice signal received by the communication interface .
Programming the voice chip .
Reading out data in the CPU of the thermoscan and combining voice and the read data .
Infrared ray emission
Y
Transmitting IR data
N
Actuating D/A circuit to output voice
SLEEP

Fig.3

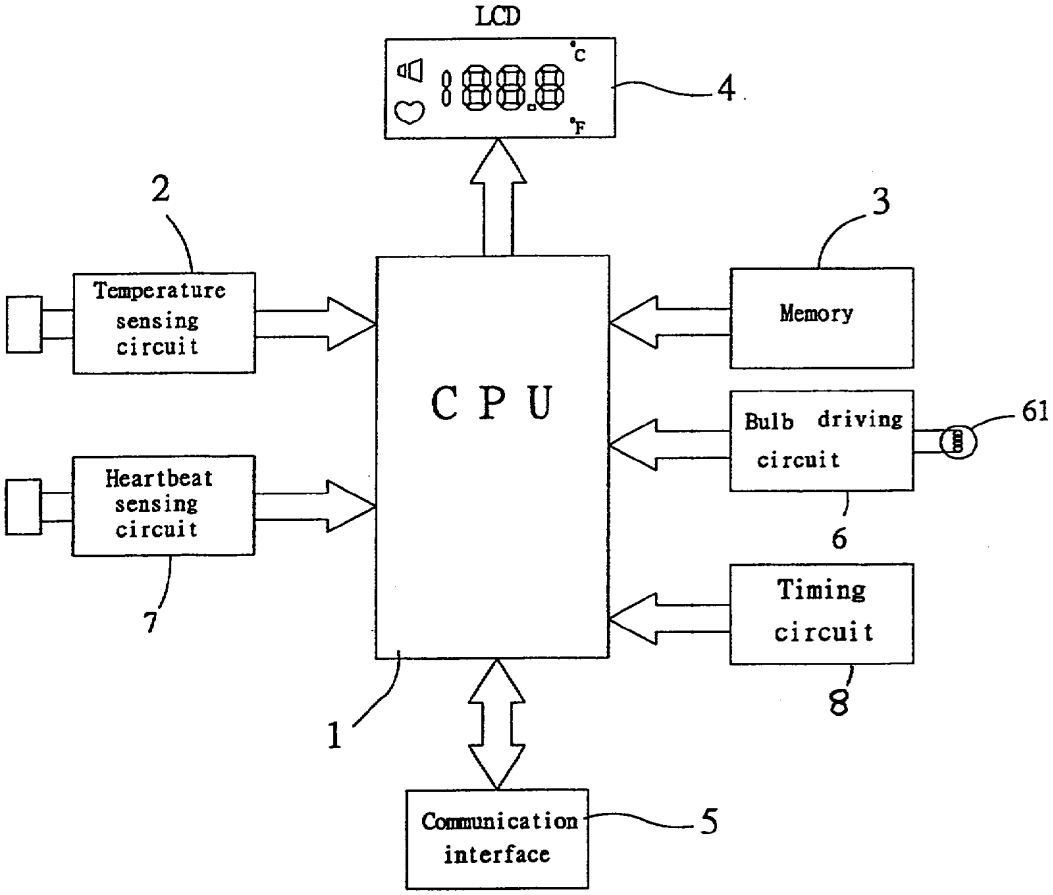
LCD
°C
°F
4
2
3
Temperature sensing circuit
Memory
CPU
Bulb driving circuit
61
Heartbeat sensing circuit
6
7
Timing circuit
8
1
Communication interface
5

Fig.4

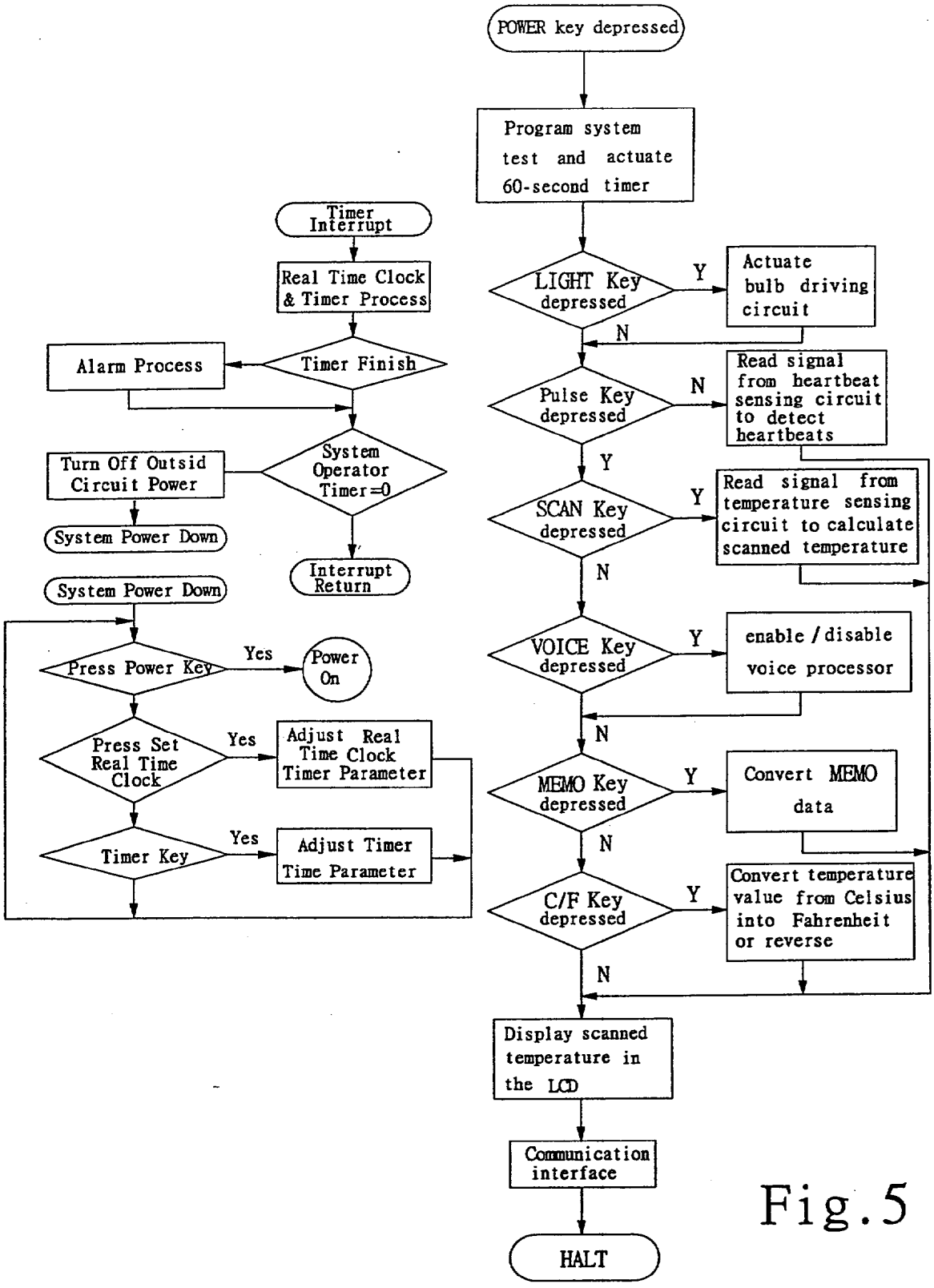
POWER key depressed
Program system test and actuate 60-second timer
LIGHT Key depressed
Y
Actuate bulb driving circuit
N
Pulse Key depressed
N
Read signal from heartbeat sensing circuit to detect heartbeats
Y
SCAN Key depressed
Y
Read signal from temperature sensing circuit to calculate scanned temperature
N
VOICE Key depressed
Y
enable / disable voice processor
N
MEMO Key depressed
Y
Convert MEMO data
N
C/F Key depressed
Y
Convert temperature value from Celsius into Fahrenheit or reverse
N
Display scanned temperature in the LCD
Communication interface
HALT
Timer Interrupt
Real Time Clock & Timer Process
Timer Finish
Alarm Process
System Operator Timer=0
Turn Off Outsid Circuit Power
System Power Down
Interrupt Return
System Power Down
Press Power Key
Yes
Power On
Press Set Real Time Clock
Yes
Adjust Real Time Clock Timer Parameter
Timer Key
Yes
Adjust Timer Time Parameter

Fig.5

THERMOSCAN

The present invention relates to a thermoscan with an improved design and, more particularly, to a thermoscan which comprises a communication interface including a voice device and infrared transmission means, and includes functions such as the heartbeat detection, illumination and the timing alarm.

There are various types of products available in the markets for taking body temperature, such as the mercurial thermometer, the paper thermometer and the thermoscan. The present invention relates to some improvements made to the internal structure of a conventional thermoscan.

A conventional thermoscan usually includes an electronic temperature sensing element for scanning the body temperature at a patient's acoustic meatus, a CPU for analog-to-digital (A/D) conversion of the sensed temperature into a value, and a liquid crystal display (LCD) for visually indicating the temperature value measured by the thermoscan. While such conventional thermoscan provides a convenient measurement of the body temperature, it has the following disadvantages:

1. The blind or people having visual difficulties can not view the temperature value displayed on the LCD; and

2. Babies and toddlers are frequently scared by and dislike the conventional thermoscan that causes uncomfortable feeling when being extended into their ears.

Therefore, it would be preferable to develop a thermoscan that provides not only a

visual reading but also an audible voice indicating the scanned temperature and/or different music to attract babies and/or children, so that the thermoscan is more convenient to use and eliminates the above mentioned problems existing in the conventional thermoscan. It would be more preferable if the temperatures scanned by the thermoscan can be stored in a personal computer or a microcomputer through infrared transmission means, so that a tracing databank is formed to effectively establish a complete family health care record. Meanwhile, the thermoscan would be more practical for use if it is provided with means for illuminating the user's acoustic meatus to facilitate inspection thereof without the need of another separate illuminating tool. Furthermore, since the thermoscan is now widely used in every family to conveniently scan the body temperature within seconds, it would be more practical for use if it is provided with other functions such as the heartbeat detection and the timing alarm.

It is therefore tried by the inventor to incorporate all the above mentioned functions on a thermoscan. That is, the thermoscan will have functions such as indication of the scanned temperature by both visual readings and audible voice, heartbeat detection, infrared transmission, illumination, and timing alarm.

In view of the foregoing, a main object of this invention is to provide a thermoscan with a communication interface that includes voice means and infrared transmission means. The thermoscan provides not only visual and voiced indication of the scanned body temperature for the convenience of the blind or people having visual difficulties, but also transmission and storage of information about the scanned body temperature with an externally connected personal computer or microcomputer via the infrared transmission means to enable the establishment of a tracing databank for effectively keeping the a family health care record.

Another object of the present invention is to provide a thermoscan that includes means

for measuring the heartbeat and therefore has an extra value for use.

A further object of the present invention is to provide a thermoscan that includes means for conveniently illuminating the acoustic meatus to facilitate inspection thereof.

Moreover, the instant invention provides a thermoscan with a timing alarm which can remind the user to re-measure the temperature or take medicine.

To achieve the above objects, the thermoscan of the present invention has a main body provided with a central processing unit (CPU) to which a temperature sensing circuit, a liquid crystal display (LCD), and a memory for storing programs are electrically connected. The temperature sensing circuit senses an infrared heat at a temperature point on the user's eardrum and sends a corresponding signal to the CPU for sampling and digitizing the signal. The digitized signal is then compared to calibrated data stored in the memory by the CPU in order to obtain the temperature value of the sensed infrared heat. The result from the comparison and calculation is then sent to the LCD for display.

The thermoscan of the present invention is characterized in that a communication interface including a voice chip and infrared transmission means is connected to the CPU. The voice chip cooperates with a speaker provided in the main body of the thermoscan to enable the voice indication of a scanned temperature value, and the infrared transmission means enables conversion of a scanned temperature into an approved communication protocol for transmitting and storing the temperature data with an externally connected personal computer or microcomputer.

The thermoscan of the present invention is also characterized in that a heartbeat sensing circuit is connected to the CPU for detecting the user's heartbeats from the finger capillary pulses. The corresponding rate of the detected heartbeats can be shown in the liquid crystal display (LCD) and/or be voiced through the speaker, and can also be stored in the externally connected personal computer or microcomputer via the infrared transmission means.

The thermoscan of the present invention is further characterized in a bulb driving circuit connected to the CPU for actuating an illuminant provided in the main body of the thermoscan.

Moreover, the thermoscan of the invention is characterized in a timing circuit connected to the CPU. The timing circuit has the functions of a clock and countdown timing, which can be displayed on the LCD, and can trigger an alarm at a preset time.

Further scope of applicability of the present invention will become apparent from the detailed description given hereinafter. However, it should be understood that the detailed description and specific examples, while indicating preferred embodiments of the invention, are given by way of illustration only, since various changes and modifications within the spirit and scope of the invention will become apparent to those skilled in the art from this detailed description.

The present invention will become more fully understood from the detailed description given hereinbelow illustration only, and thus are not limitative of the present invention, and wherein:

Fig. 1 is a block diagram of the system of a thermoscan according to a first embodiment of the present invention;

Fig. 2 is a flowchart of the system operational procedures of the thermoscan according to the present invention;

Fig. 3 is a flowchart of the communication interface operational procedures of the thermoscan according to the present invention;

Fig. 4 is another block diagram of the system of a thermoscan according to a second embodiment of the present invention; and

Fig. 5 is a flowchart of the system operational procedures of the thermoscan of Fig. 4.

Please refer to Fig. 1, which is a block diagram of the system of a thermoscan according to a first embodiment of the present invention. As shown in the drawing, the thermoscan has a main body provided with a single-chip central processing unit (CPU) 1 to which a temperature sensing circuit 2, a memory 3 for storing programs, a liquid crystal display (LCD) 4, and a communication interface 5 are electrically connected.

The CPU 1 includes an internal 14-bit A/D (analog-digital) LCD 4 driving circuit that is capable of converting analog signals from the temperature sensing circuit 2 into digitized ones. The temperature sensing circuit 2 cooperates with a temperature difference thermopile device to sense the temperature at a human eardrum. The memory 3 has corrected digital data obtained from the temperature sensing circuit 2 and the heartbeat sensing circuit 7 stored therein. In the present invention, the memory 3 may be an EEPROM. The liquid crystal display 4 is capable of displaying digits indicating values of the scanned temperature.

The communication interface 5 has a voice chip and infrared transmission means included therein. The voice chip cooperates with a digital to analog (D/A) conversion circuit to output analog signals to a speaker provided inside the main body of the thermoscan. The infrared transmission means is capable of transmitting infrared (IR) data to facilitate communication of related data between the CPU 1 and an externally connected microcomputer or personal computer.

The temperature sensing circuit 2 senses an infrared heat at a temperature point on the human eardrum and sends a corresponding signal to the CPU 1 for sampling and digitizing the signal. The digitized signal is then compared with calibrated data stored in the memory 3 and is calculated in the CPU 1 in order to obtain the temperature value of the sensed infrared heat. The result from the comparison and calculation is then sent to the

LCD 4 for display. Meanwhile, the CPU 1 outputs the temperature value to the communication interface 5.

In addition to the function of calculation, the CPU 1 also has the function of storing three entries to automatically store the temperature data before the thermoscan is powered off, so that the stored values may be used as references in the next scan. Moreover, to save power consumption by the thermoscan, the CPU 1 is provided with a 60-second power-off time switch (as shown in Fig. 2) that will automatically delay for another 60 seconds when the thermoscan is in use, in order to ensure a convenient use of the thermoscan by a user. And, the CPU 1 is so designed that it can also perform conversion of Fahrenheit degrees from and to Celsius degrees to meet different preferences of units.

Fig. 3 is a flowchart of operational procedures of the communication interface 5 included in the thermoscan of the present invention. As shown, the voice means included in the communication interface 5 cooperates with the D/A conversion circuit to output an analog signal representing a scanned temperature to the speaker inside the main body of the thermoscan, so that a voice corresponding to the scanned temperature is sounded. And, the infrared transmission means included in the communication interface 5 converts the scanned temperature value into a corresponding communication protocol and transmits the same to an externally connected microcomputer or a personal computer to facilitate the establishment of a tracing databank for the family health care record. .

The voice means may also be designed to include different musical sounds that separately correspond to different temperature values scanned by the thermoscan. Such musical sounds can attract babies and toddlers, and advantageously eliminate the children's fear to facilitate the temperature scanning.

The system depicted above comprises the structure of the communication interface means, *i.e.*, the one that includes the functions of voice and infrared transmission. The following embodiment of the instant invention further comprises a structure that includes

functions of heartbeat sensing, illumination, and timing.

Fig. 4 is a block diagram of the system of a thermoscan according to a second embodiment of the present invention. In this embodiment, the thermoscan has a main body provided with a single-chip central processing unit (CPU) 1 to which a temperature sensing circuit 2, a memory 3 for storing programs, a liquid crystal display (LCD) 4, a communication interface 5, a bulb driving circuit 6, a heartbeat sensing circuit 7, and a timing circuit 8 are electrically connected.

The CPU 1 includes an internal 14-bit A/D (analog-digital) LCD 4 driving circuit which converts analog signals from the temperature sensing circuit 2 and the heartbeat sensing circuit 7 into digital ones. The CPU 1 also enables the display of the conversion result. The temperature sensing circuit 2 cooperates with a temperature difference thermopile device to sense a temperature at a human eardrum. The memory 3 stores calibrated digital data obtained from the temperature sensing circuit 2 and the heartbeat sensing circuit 7. In the present invention, the memory 3 may be an EEPROM. The liquid crystal display (LCD) 4 displays the scanned temperature, the detected heartbeats, current time and time setting.

The communication interface 5 has a voice chip and infrared transmission means included therein. The voice chip cooperates with a digital to analog (D/A) conversion circuit to output analog signals to a speaker provided inside the main body of the thermoscan. The infrared transmission means transmits infrared (IR) data to facilitate the communication of related data between the CPU 1 and the hardware interface of an externally connected microcomputer or personal computer.

The bulb driving circuit 6 is capable of driving a bulb 61 provided in the main body of the thermoscan. The heartbeat sensing circuit 7 detects the finger capillary pulse with a sensing device and converts it into the corresponding heartbeat rate. The timing circuit 8 displays current time and the time setting via the LCD 4, and provides a reminder alarm at a

preset time with an alarm bell.

Fig. 5 is a flowchart of the system operational procedures of the thermoscan of Fig. 4. The action principle of the thermoscan system is:

1. After the system is powered on, if a LIGHT key is depressed, the bulb 61 will be driven to light up and the off automatically by the CPU 1 through an appropriate program stored in the memory 3;

2. If a PULSE key is depressed, a value provided by the heartbeat sensing circuit 7 is read by the CPU 1 through an appropriate program stored in the memory 3. The value read is then compared and calculated to display as the heartbeat rate on the liquid crystal display (LCD) 4;

3. If a SCAN key is depressed, a value provided by the temperature sensing circuit 2 is read by the CPU 1 through an appropriate program stored in the memory 3. After an analog to digital (A/D) conversion, the value read is converted into a body temperature and displayed on the liquid crystal display (LCD) 4

4. When a VOICE key is depressed, the CPU 1 uses an appropriate program stored in the memory 3 to cause a voice and synchronization circuit in the communication interface 5 to correctly voice out the digits shown on the liquid crystal display (LCD) 4 via the speaker. Moreover, the infrared transmission means can transmit infrared data to an externally connected computer;

5. When a MEMO key is depressed, the CPU 1 will immediately store a currently obtained value or show previously recorded data on the liquid crystal display (LCD) 4;

6. If a C/F key is depressed, the CPU 1 uses an appropriate program stored in the memory 3 to convert a Celsius temperature value into a Fahrenheit temperature value, or vice versa, and show the latter on the liquid crystal display (LCD) 4; and

7. The system automatically powers off when there is not any other key depressed within 60 seconds after the last operation.

In the above procedure, the countdown and timing functions of the timing circuit 8 belong to a relay circuit. When the system powers off, it enters the timing or the countdown mode. When the setting starts the countdown function, the system enters the countdown mode. Once a preset time is up, an alarm is triggered to remind the user to re-take the heartbeat rate, the ear temperature or medicine. When the thermoscan is the power-off state, the LCD 4 still continues to display the time; whereas when the system is on, it operates in the temperature or heartbeat rate taking mode. In the countdown alarming function, an extra snooze function can be added so that the alarm will continue for a period of time (*e.g.*, 30 seconds) and automatically stop without pressing any key, and then resume later on (*e.g.*, 5 minutes later) for another period of time. After the alarm, the alarm time has to be reset to re-start the countdown function.

The bulb driving circuit 6 mentioned in the above illustrated embodiment of the present invention is intended for driving the bulb 61, so that the bulb 61 emits light to illuminate the user's acoustic meatus. It is understood that the present invention is not necessarily limited to use the bulb 61 as the illuminating means. Any other illuminant capable of providing sufficient light to illuminate the acoustic meatus, such as a light emitting diode (LED), should also be construed to be within the purview of the present invention.

In the special design of the instant invention, each of the illumination function, the heartbeat rate measuring function and the ear temperature sensing function of the thermoscan has its unique action. Therefore, the user should follow the aforementioned procedure to operate individually while using. For example, when measuring the heartbeat rate, the PULSE key should be depressed and the finger bottom should lightly touch the sensing device. The sensing device receives the infrared reflection signal from the finger capillary pulse. The CPU 1 then uses an appropriate program stored in the memory 3 to read in the value from the heartbeat sensing circuit 7. The value read is then

compared and calculated to display as the heartbeat rate on the liquid crystal display (LCD) 4 or makes an output by the corresponding voice. The LIGHT key can be depressed when in need of illumination. The CPU 1 then uses an appropriate program stored in the memory 3 to light up the bulb 61

In brief, the thermoscan of the present invention has following features and advantages:

1. The voice function of the thermoscan of the present invention enables the blind and people having visual problems to use it without any difficulty.

2. The infrared transmission function of the thermoscan of the present invention enables the thermoscan to communicate with an externally connected personal computer or microcomputer for storage of data.

3. The output of musical sounds by the thermoscan attracts babies and toddlers, and eliminates their fear toward the thermoscan, so that the temperature may be easily measured via ear.

4. The 60-second power-off time switch and the automatic time delay function of the thermoscan of the present invention enable effective saving of power consumption by the thermoscan and convenient use thereof.

5. Temperature value displayed or voiced can be easily converted between Fahrenheit and Celsius degrees to meet the different preferences.

6. The thermoscan of the present invention can be used to detect the human heartbeats based on the finger capillary pulse. The detected heartbeat rate may be indicated either through the voice means included in the communication interface 5 or the LCD 4. Moreover, the detected heartbeat rate may be sent to and stored in an external personal computer or microcomputer through the infrared transmission means.

7. The independent illuminating function of the thermoscan of the present invention allows convenient check for any alien object in the acoustic meatus.

8. The temperature sensing circuit may be set to sense temperature below -20°C, so that the thermoscan of the present invention may also be used to test room temperature, water temperature, etc., and be used in different countries.

9. The digital clock and countdown functions of the thermoscan of the present invention can continue display the time and provide an alarm reminder at a preset time.

It is also understood that the CPU 1 adopted in the system block diagrams of the two embodiments shown in Figs. 1 and 4 is not necessarily limited to a single-chip CPU. For example, by taking advantage of a form of ASIC, any and all peripheral elements needed by the CPU 1, such as the driving circuit for the liquid crystal display (LCD) 4, the A/D and D/A conversion circuits, and the voice circuit, can be included in one single chip to achieve the same objects and functions without departing from the spirit of the present invention.

The invention being thus described, it will be obvious that the same may be varied in many ways. Such variations are not to be regarded as a departure from the spirit and scope of the invention, and all such modifications as would be obvious to one skilled in the art are intended to be included within the scope of the following claims.

CLAIMS

What is claimed is:

1. A thermoscan comprising a main body provided in an inner space with a central processing unit (CPU) to which a temperature sensing circuit, a liquid crystal display (LCD), and a memory for storing programs are electrically connected; said temperature sensing circuit being adapted to sense an infrared heat at a temperature point on a human ear-drum and sending a corresponding signal to said CPU for sampling and digitizing the signal, a digitized signal being then compared to calibrated data stored in said memory and calculated in the CPU in order to obtain the temperature value of the sensed infrared heat, which is then sent to said LCD for display; wherein said thermoscan is characterized in that said CPU further connects to a communication interface, said communication interface including a voice chip and infrared transmission means, said voice chip cooperating with a speaker provided in said main body of said thermoscan to enable a voice indication of a scanned temperature value via said speaker, and said infrared transmission means enabling conversion of said scanned temperature value into a communication protocol for transmitting and storing said scanned temperature with an externally connected personal computer or microcomputer.

2. The thermoscan of claim 1, wherein said thermoscan further comprises a heartbeat sensing circuit electrically connected to said CPU for detecting the human heartbeats based on the finger capillary pulse, a heartbeat rate detected by said heartbeat sensing circuit being indicated either through said voice means of said communication interface or through said LCD, and said detected heartbeat rate being sent to and stored in said external personal computer or microcomputer through said infrared transmission means of said communication interface.

3. The thermoscan of claim 1 or claim 2, wherein said thermoscan further comprises a bulb driving circuit electrically connected to said CPU for driving an illuminant provided in said

main body of said thermoscan to emit light.

4. The thermoscan of claim 3, wherein said illuminant can be a bulb or a light emitting diode (LED).

5. The thermoscan of any one of the claims 1 to 4, wherein said thermoscan further comprises a timing circuit connected to said CPU, said timing circuit further including the clock and countdown functions which display the time and countdown setting via said LCD and provide an alarm reminder at a preset time.

6. The thermoscan of any one of the claims 1 to 5, wherein the peripherals of said CPU, including a LCD driving circuit, an A/D conversion circuit, and a voice circuit, are provided on an ASIC single chip.

7. A thermoscan substantially as herein described with reference to Figures 1, 2 and 3 or Figures 4, 5 and 3 of the accompanying drawings.

Amendments to the claims have been filed as follows

CLAIMS:

1. An ear thermometer comprising a main body provided in an inner space with a central processing unit (CPU) to which a temperature sensing circuit, a liquid crystal display (LCD), and a memory for storing programs are electrically connected; the temperature sensing circuit being adapted to sense an infrared heat at a temperature point on a human eardrum and send a corresponding signal to said CPU for sampling and digitizing the signal, the digitzed signal being then compared to calibrated data stored in said memory and calculated in the CPU in order to obtain the temperature value of the sensed infrared heat, which is then sent to the said LCD for display;

wherein the said ear thermometer is characterized in that the CPU further connects to a communication interface which includes a voice chip and infrared transmission means, the said voice chip cooperating with a speaker provided in the said main body to enable a voice indication of a scanned temperature value via the said speaker, and the infrared transmission means enabling conversion of the said scanned temperature value into a communication protocol for transmitting and storing the said scanned temperature with an externally connected personal computer or microcomputer;

the ear thermometer further comprises a heartbeat sensing circuit electrically connected to the said CPU for detecting human heartbeats based on a finger capillary pulse, a heartbeat rate detected by the said heartbeat sensing circuit being indicated either through the said voice chip or through the LCD, and being sent to and stored in the said external personal computer or microcomputer through the said infrared transmission means; and

the ear thermometer further comprises a bulb driving circuit electrically connected to said CPU for driving an illuminant provided in the said main body to emit light.

2. An ear thermometer according to Claim 1, wherein the said illuminant can be a bulb or a light emitting diode (LED).

3. An ear thermometer according to Claim 1 or 2, wherein the ear thermometer further comprises a timing circuit connected to said CPU, the timing circuit further including clock and countdown functions which display the time and countdown setting via the said LCD and provide an alarm reminder at a preset time.

4. An ear thermometer according to any preceding claim wherein peripherals of the said CPU, including an LCD driving circuit, an A/D conversion circuit, and a voice circuit, are provided on an ASIC single chip.

5. An ear thermometer substantially as hereinbefore described with reference to Figures 1, 2 and 3 or Figures 4, 5 and 3 of the accompanying drawings.

The Patent Office

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INVESTOR IN PEOPLE

Application No: GB 9926314.7 **Examiner:** Simon Colcombe
Claims searched: All **Date of search:** 23 December 1999

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.Q): G1A (AAMA, AAMH, AAMT) : G1N (NEAN, NEAX, NENT)

Int Cl (Ed.6): A61B 5/00 : G01K 13/00

Other: Online: WPI, EPODOC, JAPIO

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
A	GB 2284060	(HORTON)	
A	GB 2274514	(CIBERVEU)	
A	US 5790586	(HILTON)	
A	US 5673692	(SCHULZE)	

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.